



LEL DIVISION
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CATALOG 371



MICROWAVE ■ RF ■ IF RECEIVING SYSTEMS AND COMPONENTS

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PRODUCTS / CAPABILITIES / FACILITIES

LEL has made significant advances in the development and manufacture of microwave, r-f and i-f receiving systems, and components for a wide variety of applications in telemetry, navigation, guidance, control, terrestrial- and aerospace-communications systems. From RELAY through APOLLO, LEL components have been chosen for quality, performance, and reliability. LEL amplifiers, mixer-preamplifiers, receiver sub-assemblies, and LEL-LINE strip components are used world-wide in critical military and commercial applications.

Our latest products and capabilities are the microwave integrated circuits shown on page two. These devices feature extremely small size, high-temperature operating capabilities and uniform package configurations. In addition to the products shown, we will be introducing additional devices and more complex assemblies in the near future.

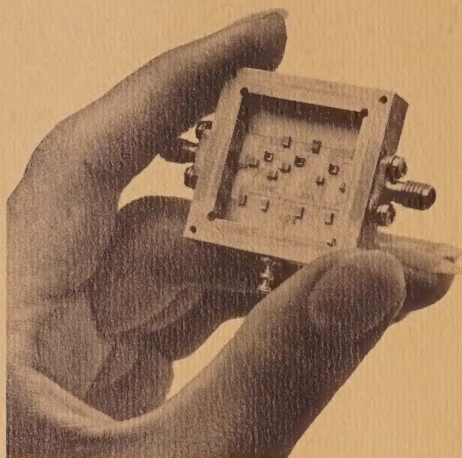
Typical of other advanced capabilities are the down converters and receiver front ends listed in this catalog. Small, low-noise, high-reliability equipment for specific critical applications results from LEL's highly specialized knowledge and accumulated experience in receiving systems engineering.

LEL's facilities are continually being expanded and improved to keep pace with industry developments. Our quality control and test procedures have been approved by the Nation's leading prime contractors.

INTEGRATED CIRCUITS

LOW-NOISE INTEGRATED PREAMPLIFIER

Thin-film and integrated-circuit techniques are used in LEL's new low-noise, wide-dynamic range preamplifier. The IHP-1 series of preamplifiers, occupying only 0.5 cubic inch, features specifications comparable to conventional point-to-point wiring techniques. Standard models are available within 30 days.



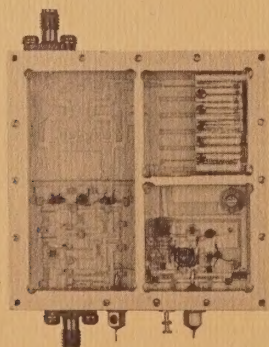
IHP-1

CHARACTERISTICS IHP-1

Center Frequency	30, 60, or 70 MHz
Bandpass, 3 dB, minimum	10 or 100 MHz
Flatness	± 0.5 dB
Gain, minimum	32 dB
Noise Figure, typical	2.5 dB
Noise Figure, maximum	3.0 dB
Input Impedance	50 Ω
VSWR	2:1
Power Output, at 1 dB compression, minimum	0 dBm
Input Voltage	+12 Vdc
Input Current	50 mA
Size	1.3 x 1.3 x 0.3 in

INTEGRATED TELEMETRY DOWN CONVERTER

The SFCM-1485 telemetry down converter is fabricated on 0.025 inch alumina substrates. The mixer circuit consists of a microstrip folded branch line hybrid feeding two beam lead Schottky barrier diodes. The integral local oscillator's signal is filtered through a five pole Combline filter before being fed to the mixer. The i-f signal then travels through a matching transformer to a three-stage i-f amplifier. By suitable choices of circuit constants, center frequency and bandwidth of the basic i-f amplifier can be altered to obtain a great variety of i-f characteristics. Due to a modular design approach, the down converter may be easily and inexpensively adapted to meet special requirements.

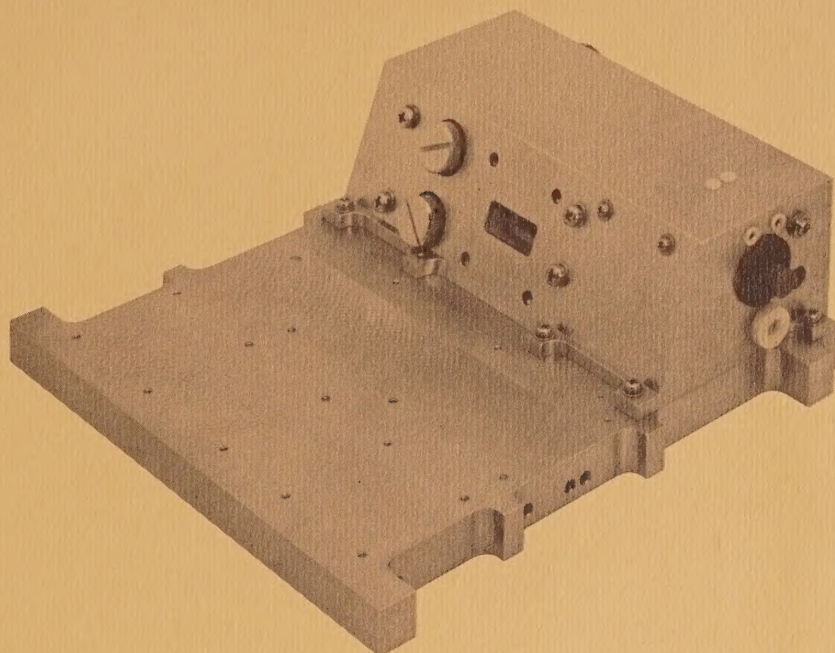


SFCM-1485

CHARACTERISTICS SFCM-1485

Input Frequency	1435-1535 MHz
IF Frequency	30, 60, or 265 MHz
IF Bandwidth	10, 20, or 100 MHz
Conversion Gain	15-30 dB
Power Output, at 1 dB compression, maximum	
30 or 60 MHz IF	0 dBm
265 MHz IF	-5 dBm
Noise Figure, maximum	8.0 dB
Noise Figure, typical	7.5 dB
VSWR, input and output	<1.5:1
Impedance, input and output	50 Ω
Frequency Accuracy	$\pm .01$ %
Frequency Stability	70 ppm/ $^{\circ}$ C
Supply Voltage	+9 Vdc

PULSE
MODULATION
RECEIVERS
FOR L, S, C, X,
AND K BANDS



OMR-1

OMR-1 series solid-state microwave receivers are readily available in all frequency ranges between 500 MHz and 40 GHz. The X-band model (OMR-1) features field-tunable r-f inputs, a typical L.O. search range of 50 MHz, AFC lock-on signal levels to -95 dBm, and constant video output with input signals between -90 and -50 dBm. Design is in accordance with requirements of MIL-E-5400.

CHARACTERISTICS
OMR-1 (X-Band Model)

RF Signal Input, field tunable	9.75 to 10.6 GHz*
Noise Figure, typical	10 dB
Voltage Gain	115 dB
AGC Range	>65 dB
AFC Range	± 20 MHz
Pulse Width, at 1 KHz repetition rate	1 μ s
Video Output	4.25-4.75 V p-p
Power Supply Requirements	
+14 Vdc	90 mAdc
-14 Vdc	60 mAdc
-300 Vdc	45 mAdc
-600 Vdc	3 mAdc
Filament	6.3 V

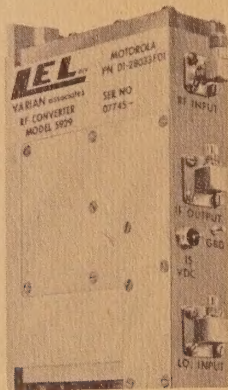
*Other models, with frequencies ranging from 500 MHz to 40 GHz, are available.

CONVERTERS

CONVERTER/
RECEIVER
ASSEMBLIES

LEL's S-band receiver combines a preselector, frequency multiplier, mixer, and i-f amplifier in an 8 ounce package which occupies less than 15 cubic inches. The package has an over-all noise figure of 8 dB and is designed to assure high-

reliability telemetry data reception and voice communication. Similar receivers are available for other r-f frequencies or may be provided with characteristics to meet your requirements.



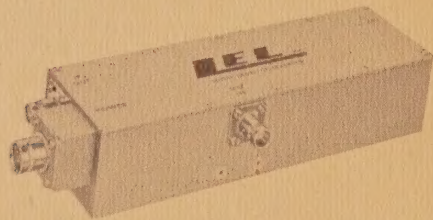
SDC-2000

CHARACTERISTICS
SDC-2000

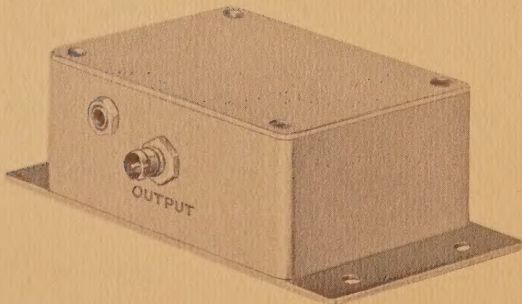
RF Input	2100 MHz
L.O. Input, at + 16 dBm	225 MHz
RF to IF Gain	22 dB
Noise Figure, at 25°C	7.5 dB
IF Center Frequency	50 MHz
IF Bandwidth, at 3 dB	20 MHz
Input Power, for linear output, maximum	-35 dBm
Power Consumption	<150 mW
Cross Modulation Suppression	>40 dB

CONVERTERS —
SOLID STATE

RTC converters are rugged, low-noise solid-state devices designed to convert r-f signals in the 80- to 400-megahertz range to i-f of 30, 60, or 70 megahertz.



RTC-1, 2



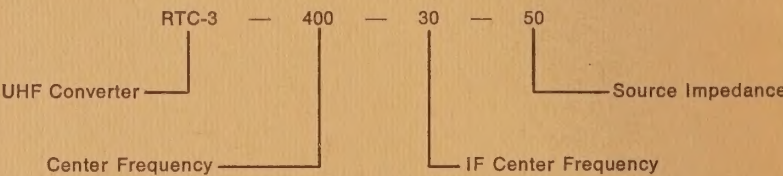
RTC-3

CHARACTERISTICS

		RTC-1	RTC-2	RTC-3
RF Frequency	(MHz)	160	160	80-400
RF Bandwidth, minimum	(MHz)	35	35	20
IF Frequency	(MHz)	30/60/70	30/60/70	30/60/70
IF Bandwidth	(MHz)	12/20	12/20	20
Gain, minimum	(dB)	30	30	15
Noise Figure, maximum	(dB)	3.0	3.0	6
Linear Input	(dBm)	-25	-25	-25
Supply Voltage	(V)	-15	-15	+20
Supply Current	(mA)	120	100	—
Internal L.O.		Yes	No	Yes

ORDERING INFORMATION

Specify model by part number per following example:



CHARACTERISTICS SFC-2250

Frequency Response:	
Preconversion	2200 to 2300 MHz*
Postconversion	215 to 265 MHz
Frequency Stability	± 0.001 %
Phase Jitter, from 1.5 kHz to 1 MHz	$\leq \pm 5$ °
Phase Linearity, over any 5-MHz passband	± 9 °
Gain, nominal	40 dB
Gain Stability, at any given passband for <24 h	± 1 dB
AGC Output, for inputs up to 0 dBm	0 ± 2 dBm
Impedance, input and output	50 Ω
VSWR, input and output	<2:1
Intermodulation Distortion, up to 0 dBm input	≤ 3 %
Noise Figure, maximum	8.5 dB
RFI	per MIL-I-6181D
Temperature Range	+20 to +150 °F
Input Power, maximum	200 W
Voltage, rms	115 ± 10 Vac
Frequency	60 Hz

*Also available for the 1435 to 1540 MHz or the 1700 to 1850 MHz telemetry bands.

The SFC-2250 is a completely self-contained, standard rack mounted, solid-state telemetry down converter having wide dynamic range. It is comprised of bandpass filters, a tunnel diode amplifier, a L.O.-frequency multiplier package, an amplifier-mixer, an amplifier detector (AGC) and a power supply. Down converters operating at different frequencies or having other desired characteristics are readily available.

TELEMETRY DOWN CONVERTERS



SFC-2250

CHARACTERISTICS

LFC-1485-1* LFC-1485-2**

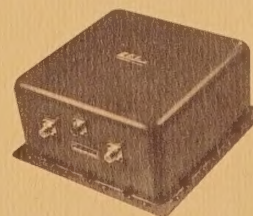
Frequency			
Preconversion	(MHz)	1435-1535	1435-1535
Postconversion	(MHz)	215-315	215-315
Noise Figure, maximum	(dB)	10	7
RF to IF Gain, minimum	(dB)	25	25
Intermodulation, below signal			
For 2 signals at -25 dBm	(dB)	30	—
For 2 signals at -35 dBm	(dB)	—	30
Impedance, input and output	(Ω)	50	50
VSWR, input and output		1.5:1	1.5:1
AGC Range, minimum	(dB)	20	20
Image Rejection	(dB)	>70	>70
RF to IF Ripple	(dB)	1	1
Input Voltage, 60 Hz	(V)	115	115

*without r-f amplifier

**with r-f amplifier

LFC-1485-1 and LFC-1485-2 solid-state down converters are self-contained units which convert and amplify L-band (1435-1535 MHz) telemetry signals to VHF (215-315 MHz). Each of these units features wide dynamic range, low noise figure and excellent frequency stability. The converters are available without microwave amplifiers (-1 series) and with microwave amplifiers (-2 series) for lower noise figures. Both types withstand +20 to +160°F temperature variation and 95% humidity. They are packaged in 12 x 12 x 6 inch weatherproof housings.

TELEMETRY DOWN CONVERTERS



LFC-1485

MIXER-PREAMPLIFIERS

- LOWER POWER
- WIDER DYNAMIC RANGE
- SMALLER SIZE AND WEIGHT
- LOWER COSTS

LEL quality mixer-preamplifiers consist of a preamplifier carefully mated electrically and mechanically with a microwave mixer to form a single, high-performance assembly well suited to use in a broad range of applications, including radar, guidance, and communications systems.

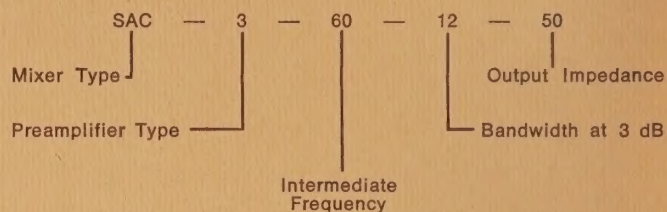
Sufficient preamplifier gain is provided so that no special postamplifier input circuitry is required to minimize over-all noise figure. The units operate into terminated 50-, 75- or 93-ohm lines permitting placement of the postamplifier in any location.

Each mixer-preamplifier is bench aligned and calibrated before shipment. All units are tested for noise figure, power gain, and bandwidth over the specified frequency range and measurement data are supplied with the unit. Matching postampli-

fiers having appropriate gain, bandwidth, recovery time, AGC response or other desired characteristics are available. Consult the amplifier pages of this catalog.

ORDERING INFORMATION

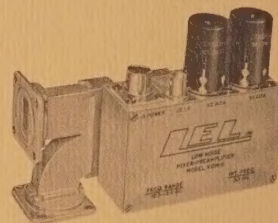
Order by part number as in the following example:



STANDARD MIXER CHARACTERISTICS

WAVEGUIDE TO WAVEGUIDE HYBRID

STANDARD MODELS					
Frequency (GHz)	Model Number	Noise Figure* incl. 30 MHz IF of 1.2 dB (dB)	Typical RF Input VSWR	Typical L.O. Input Power (mW)	Minimum L.O./RF Isolation (dB)
3.95- 4.5	CBH	6.5- 7.0	1.3:1	1	13
4.5- 5.15	CCH	6.5- 7.0	1.5:1	1	13
5.15- 5.85	CDH	6.5- 7.0	1.2:1	1	13
7.3- 8.5	XAH	6.5- 7.0	1.2:1	1	13
8.5- 9.6	XBH	6.5- 7.0	1.2:1	1	13
9.4-10.3	XCH	6.5- 7.0	1.2:1	1	13
10.3-11.5	XDH	8.5- 9.5	1.2:1	1	13
12.4-14.5	KAH	8.5- 9.0	1.2:1	1	13
14.5-17.0	KBH	8.5- 9.0	1.2:1	1	13
23.0-25.0	KCH	9.0- 9.7	1.3:1	1	13
34.0-36.0	KDH	9.0-10.0	1.2:1	1	13



XDH-2

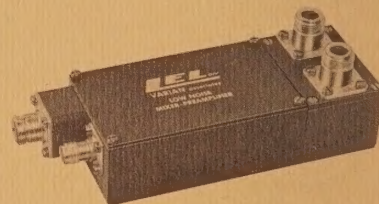


UFK-7

WAVEGUIDE TO WAVEGUIDE ORTHOGONAL AND TEE

STANDARD MODELS					
Frequency (GHz)	Model Number	Noise Figure* incl. 30 MHz IF of 1.2 dB (dB)	Typical RF Input VSWR	Typical L.O. Input Power (mW)	Minimum L.O./RF Isolation (dB)
8.2-12.4	XDB	8.0- 9.0	3.5:1	2	15
12.4-18.0	KAB	8.0- 9.0	3.0:1	2	15
18.0-26.5	KFT	10.5-11.5	5.0:1	2	15
26.5-40.0	KGT	11.0-12.0†	5.0:1	2	15

† 17 dB max. between 38 and 40 GHz



LAK-9

COAX TO COAX

STANDARD MODELS					
Frequency (GHz)	Model Number	Noise Figure* incl. 30 MHz IF of 1.2 dB (dB)	Typical RF Input VSWR	Typical L.O. Input Power (mM)	Minimum L.O./RF Isolation (dB)
0.2-1.0	U FK	7.0-8.0	2.0:1	2	15
0.9-1.8	LAK	7.0-8.0	2.0:1	2	15
1.0-2.0	LAC	8.0-8.5	1.3:1	1	6
1.7-2.4	SAC	8.0-8.5	1.3:1	1	6
2.0-4.0	SBC	8.0-8.5	1.3:1	1	6
4.0-7.0	CAC	8.0-8.5	1.3:1	1	6
4.0-8.0	CJC	8.0-9.5	1.3:1	1	6



UFK-10

*Noise figure of mixer-preamplifiers is determined by adding the figure shown under "IF Noise Figure over 1.2 dB" for the required preamplifier to the range given for the mixer selected. EXAMPLE: A CBH mixer mated with a -3 preamplifier having a 60 MHz center frequency and 8 MHz bandwidth has a noise figure range of 6.5 to 7.0 dB plus 0.4 dB; thus the noise figure range is 6.9 to 7.4 dB.

STANDARD PREAMPLIFIER CHARACTERISTICS

Center Frequency (MHz)	Bandwidth (MHz)	RF to IF Gain† (dB)	IF Noise Figure* over 1.2 dB (dB)	Max. Mixer Input Signal‡ (dBm)
30	8	24	0	-10
30	12	20	0	-7
60	8	24	0.4	-10
60	12	20	0.4	-7
70	8	23	0.7	-10
70	12	20	0.7	-7

Basic unit preferred for low noise figure or wide dynamic range. Power requirements are: +150 Vdc at 45 mAdc and 6.3V at 0.6 A. Output impedance: 50, 75 or 93 ohms.

—2 MINIATURE TUBE

Center Frequency (MHz)	Bandwidth (MHz)	RF to IF Gain† (dB)	IF Noise Figure* over 1.2 dB (dB)	Max. Mixer Input Signal‡ (dBm)
30	8	40	0	-33
30	12	32	0	-27
60	8	40	0.4	-33
60	12	32	0.4	-27
60	20	24	0.8	-20
70	8	38	0.7	-33
70	12	30	0.7	-27
70	20	24	1.1	-20

Provides higher gain, permits greater flexibility of i-f circuitry than -2. Power requirements are: +150 Vdc at 60 mAdc and 6.3 V at 0.9 A +10 V bias. Output impedance: 50, 75 or 93 ohms.

—3 MINIATURE TUBE

Center Frequency (MHz)	Bandwidth (MHz)	RF to IF Gain† (dB)	IF Noise Figure* over 1.2 dB (dB)	Typical Mixer Input Signal‡ (dBm)
30	12	24	1.0	-30
30	20	19	1.0	-30
60	12	24	1.0	-30
60	20	19	1.0	-30
70	12	24	1.0	-30
70	20	19	1.0	-30

Basic unit preferred for small size, low power drain, broad bandwidth. Silicon transistors for operation to 100°C. Power requirements are: -20 Vdc or -27 Vdc at 10 mA. Output impedance: 50, 75 or 93 ohms.

—7 SOLID STATE

Center Frequency (MHz)	Bandwidth (MHz)	RF to IF Gain† (dB)	IF Noise Figure* over 1.2 dB (dB)	Max. Mixer Input Signal‡ (dBm)
160	50	24	3.0	-10
250	100	20	3.0	-5

Provides broader bandwidth, greater dynamic range than -7 series. Silicon transistors. Power required is: -20 Vdc at 47 mAdc. Output impedance: 50, 75 or 93 ohms.

—9 SOLID STATE

The following characteristics apply for any single r-f frequency specified.

Center Frequency (MHz)	Bandwidth (MHz)	Typical RF to IF Gain† (dB)	IF Noise Figure* over 1.2 dB (dB)	Max. Mixer Input Signal‡ (dBm)
30	20	20	2.0	-20
60	25	20	2.0	-20
70	25	20	2.0	-20

Phase tracking is 2° max. and gain tracking is 1 dB max. (when compared to a similar unit with a common AGC bias). Phase and gain trim are chassis adjustments. Gain reduction is 20 dB. Output impedance: 50 ohms. Power requirements are: -20 Vdc at 25 mAdc.

For phased-array, monopulse receivers or similar applications where gain-and-phase tracking are primary requirements, LEL offers mixer-preamplifiers in phase-and-gain matched sets of 2 or more. Characteristics of these units are matched over the temperature and gain control ranges. See also i-f amplifiers (ITA-8) in this catalog.

—10 MATCHED MULTICHANNEL MIXER-PREAMPLIFIERS

†R-F to i-f power gain: 6 dB (assumed mixer loss) has been deducted from preamplifier gain in determining stated values.

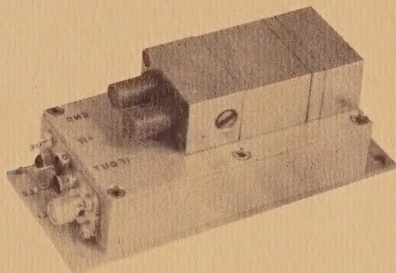
‡For linear operation, an input power increase of 3 dB over the stated "mixer input signal" level will result in less than 1 dB of output signal compression.

MIXER- PREAMPLIFIERS

—11 MINIATURE SOLID-STATE MIXER- PREAMPLIFIERS

MINIATURE COAX MIXER CHARACTERISTICS

MINIATURE PREAMPLIFIER CHARACTERISTICS



XMC-11

BROADBAND MIXER- PREAMPLIFIERS

The BMP series of broadband mixer/preamplifiers are extremely useful in ECM, multi-antenna, mono-pulse direction finding equipment. In such systems, they can replace several mixer-preamplifiers

many receiver applications. Standard miniature mixer and preamplifier characteristics are shown separately below. Connectors are OSM/OSM type.

STANDARD MODELS					
Frequency (GHz)	Model Number	Noise Figure* with 30 MHz IF of 1.2 dB (dB)	Typical RF Input VSWR	Typical L.O. Input Power (mW)	Minimum L.O./RF Isolation (dB)
1.0- 2.0	LMC	7.5- 8.5	1.3:1	2	6
2.0- 4.0	SMC	8.0- 9.0	1.3:1	2	6
4.0- 8.0	CMC	8.5- 9.5	1.5:1	2	6
8.0-12.0	XMC	9.0-10.0	1.7:1	2	6

CHARACTERISTICS				
Center Frequency (MHz)	Band-width (MHz)	RF to IF Gain† (dB)	IF Noise Figure* over 1.2 dB (dB)	Max. Mixer Input Signal‡ (dBm)
30	20	20	1.0	− 24
60	20	20	1.0	− 24
70	20	20	1.0	− 24

CHARACTERISTICS BMP-1-160-100-5											
RF Frequency Range (GHz)	IF Frequency† (MHz)	IF Bandwidth† (MHz)	Typical Noise Figure (dB)	Maximum Noise Figure (dB)	Maximum VSWR	Minimum L.O. to RF Isolation (dB)	L.O. Drive Level (mW)	RF to IF Gain (dB)	Maximum Input, 1 dB output compression (dBm)	Supply Voltage (Vdc)	Supply Current (mA)
2.0-10	160	100	11.5	13.0	1.50:1	8	2	17	− 16	+20/ − 20	25
1.5-12*	160	100	11.5	13.0	1.75:1	6	2	17	− 16	+20/ − 20	25

†Other i-f frequency and bandwidth combinations are available including i-f frequencies up to 1 GHz.

* This is an extended range version of the BMP-1-160-100-5



BMP-1

*Noise figure of mixer-preamplifiers is obtained by adding range given for the mixer selected and the figure shown under "IF Noise Figure over 1.2 dB" for the required preamplifier. EXAMPLE: A CBH mixer mated with a −3 preamplifier having a 60 MHz center frequency and 8 MHz bandwidth has a noise figure range of 6.5 to 7.0 dB plus 0.4 dB; thus the noise figure range is 6.9 to 7.4 dB.

STANDARD MODELS

Model Number	Frequency Range (MHz)	Minimum L.O. - RF Isolation (dB)	Dimensions (in)
MSS-2-1500	1400-1600	10	4.0x5.5x1.0
MSS-2-1700	1575-1825	10	4.0x5.5x1.0
MSS-2-2250	2100-2400	10	3.5x5.5x1.0
MSS-2-3000	2800-3200	10	3.5x5.5x1.0
MSS-2-4000	3700-4200	10	3.0x5.5x1.0
MSS-2-5650	5350-5900	10	3.0x5.5x1.0

ORDERING INFORMATION

Order by part number as in the following example:



STANDARD MODELS

Model Number	Frequency Range (GHz)	Outputs	Length (in)	Width (in)
DSB-1-5402	0.5-4.0	2	10.5	2.5
DSB-1-5404	0.5-4.0	4	12.0	5.0
DSB-1-5408	0.5-4.0	8	12.0	10.0

STANDARD MODELS

Model Number	Frequency Range (MHz)	Outputs	Length (in)	Width (in)
CSI-1-1002	1000-2000	2	5.0	3.5
CSI-1-2002	2000-4000	2	4.0	3.0
CSI-1-3002	3200-5800	2	4.0	3.0
CSI-1-1004	1000-2000	4	5.5	4.5
CSI-1-2004	2000-3800	4	5.5	4.5
CSI-1-3004	3200-5800	4	5.5	4.5

STANDARD MODELS

Model Number	Frequency Range† (GHz)	Coupling† (dB)
BBC-30-550	0.5- 5.0	3.0‡
BBC-100-550	0.5- 5.0	10.0
BBC-200-550	0.5- 5.0	20.0
BBC-30-111	1.0-11.0	3.0‡
BBC-100-111	1.0-11.0	10.0
BBC-200-111	1.0-11.0	20.0

†Other frequency ranges and coupling values are obtainable on request.

‡Does not include 0.5 dB insertion loss. Three dB couplers are internally terminated. Others require external terminations.

GENERAL CHARACTERISTICS

Frequency Range	1400 to 5900 MHz
Noise Figure*, maximum	10.0 dB
Noise Figure*, typical	9.0 dB
Image Suppression, minimum	20.0 dB
L. O. Power Requirements	5 to 10 mW
Signal Port VSWR, maximum	2:1

*Measured with a 30 MHz i-f combiner of 20% bandwidth and 1.5 dB i-f noise figure.

CHARACTERISTICS

Frequency Range	0.5 to 4.0 GHz
VSWR, maximum	1.7:1
Impedance	50 Ω
Insertion Loss, ± 0.3 dB, including split loss	
2-way Dividers	3.0-3.6 dB
4-way Dividers	6.0-7.0 dB
8-way Dividers	9.0-10.2 dB

CHARACTERISTICS

Frequency Ranges	1000-5800 MHz
Bandwidth	Up to an octave
Minimum Isolation	
2-way Dividers	15 dB
4-way Dividers	13 dB
Maximum VSWR	
2-way Dividers	1.8:1
4-way Dividers	2.0:1
Insertion Loss, ± 0.3 dB, including split loss	
2-way Dividers	3.0-3.6 dB
4-way Dividers	6.0-7.0 dB

CHARACTERISTICS

Coupling Tolerance	± 1 dB
Typical Directivity	15 dB
Maximum VSWR	1.5:1
Connector Type	OSM †

The MSS-2 series of miniature ISM's employ replaceable Schottky diodes and offer excellent performance particularly when used with LEL's HCQ-ISM i-f hybrids. These mixers are supplied with 4 i-f output connectors of the OSM type. Each mixer requires a quadrature hybrid at the desired i-f center frequency. A specially-designed standard quadrature hybrid is available with 30 or 60 MHz center frequencies; these devices also permit monitoring of the individual mixer diode currents.

IMAGE
SUPPRESSION
MIXERS

DSB series power dividers are wideband, low-loss, reactive type units.

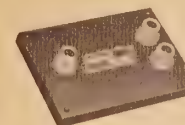
BINARY
POWER
DIVIDERS



DSB-1

CSI units are ideal for many divider and combiner applications including use in phased-array systems. Two- and 4-way dividers are standard; 8-way dividers are available on special order only.

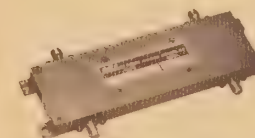
HIGH
ISOLATION
POWER
DIVIDERS/
COMBINERS



CSI-1

BBC directional couplers permit use of a single coupler over a complete microwave frequency decade.

BROADBAND
COUPLERS



BBC

LEL-LINE STRIP COMPONENTS

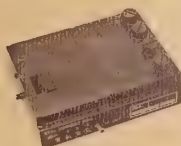
IMAGE SUPPRESSION MIXERS

LEL-LINE microwave strip transmission line components offer excellent performance and field proven reliability. For laboratory or system applications, these devices feature performance comparable to narrow band devices but at bandwidths up to 4 octaves. Advanced design and manufacturing techniques assure fast delivery of standard models, custom-designed units or matched component assemblies.

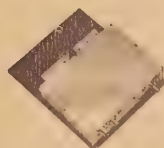
IMAGE SUPPRESSION DEVICES

The successful application of LEL-LINE techniques has resulted in a wide variety of special ISM assemblies. Besides the mixers listed here, image suppression assemblies are available at frequencies from 200 MHz to 18 GHz—with a broad selection of i-f frequencies and bandwidths. Models have been delivered with dual phase and gain matched preamps for minimum noise figure, remote sideband switching, multi-channel systems, sub-miniature packaging for missile applications, and broadband models through Ku band.

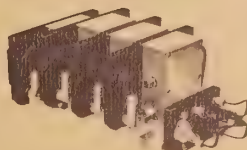
BINARY POWER DIVIDERS



HIGH ISOLATION POWER DIVIDERS/ COMBINERS



BROADBAND COUPLERS



IF COMPONENTS

LEL i-f amplifiers are used throughout the world in spacecraft, air and ground installations, and in both military and commercial applications including radar, communications, guidance and navigation systems. Standard models available from stock include miniature and sub-miniature tube or transistor types. Modified standard units and cus-

tom designed units or assemblies are readily available.

Each unit is tested for gain, bandwidth, noise figure, balance and over-all performance. Actual numerical test data are furnished with each unit. Amplifiers with noise figures lower than stated catalog values can be furnished on special order.

PREAMPLIFIERS— MINIATURE TUBE TYPE

LEL low-noise preamplifiers are compact units of quality construction to assure excellent long term performance.

GENERAL CHARACTERISTICS

Output	IF
Minimum IF Gain	40 dB
Power Supply Requirements	
Voltage, at 50 mAdc	+ 150 Vdc
Voltage, at 1.2 A	6.3 V
Bias Voltage	0 to -6 V
Dimensions	8.5 x 3.25 x 2.5 in
Weight	24 oz



IF-31

STANDARD MODELS

Model Number	Center Frequency (MHz)	3-dB Bandwidth (MHz)	Source Impedance (Ω)	Max. Noise Figure (dB)
IF-31-30-08-S	30	8	300	12
IF-31-60-08-S	60	8	300	12
IF-31-60-20-S	60	20	300	12
IF-31-70-08-S	70	8	300	12
IF-31-70-20-S	70	20	300	12
IF-31-30-08-P	30	8	300	12†
IF-31-60-08-P	60	8	300	12†
IF-31-60-20-P	60	20	300	12†
IF-31-70-08-P	70	8	300	12†
IF-31-70-20-P	70	20	300	12†
IF-31-30-08-PP	30	8	300	12‡
IF-31-60-08-PP	60	8	300	12‡
IF-31-60-20-PP	60	20	300	12‡
IF-31-70-08-PP	70	8	300	12‡
IF-31-70-20-PP	70	20	300	12‡
IF-31-30-08-50	30	8	50	—
IF-31-60-08-50	60	8	50	—
IF-31-60-20-50	60	20	50	—
IF-31-70-08-50	70	8	50	—
IF-31-70-20-50	70	20	50	—

† Suffix indicates mixer type.

S: Single ended mixer,

P: Balanced mixer using reversed diodes,

PP: Balanced mixer using pushpull diodes,

50: standard mixer.

‡ Each diode = 12 pF.

ULTRA- MINIATURE PREAMPLIFIERS— SOLID STATE

STANDARD MODELS

Model Number	Center Frequency (MHz)	3-dB Bandwidth (MHz)	Source Impedance (Ω)	Gain (dB)	Max. Noise Figure (dB)	Supply Voltage (Vdc)	Supply Current (mAdc)
ITP-3-30-10-50	30	10	50	30	2.5	+12	50
ITP-3-60-10-50	60	10	50	30	2.5	+12	50
ITP-3-60-100-50	60	100	50	30	2.5	+12	50



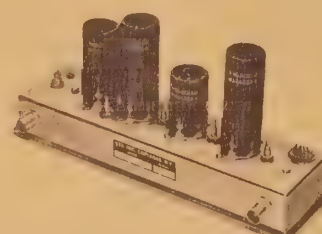
ITP-3

STANDARD MODELS

Model Number	Center Frequency (MHz)	3-dB Bandwidth (MHz)	Max. Noise Figure (dB)	Gain (dB)	Source Impedance (Ω)
IMV-1-30-10-50	30	0.3-10.0	2.5	30	50
IMV-1-60-20-50	60	0.8-20.0	3.0	30	50
IMV-1-70-20-50	70	1.0-20.0	3.5	30	50
ITV-1-30-10-50	30	1.0-10.0	8.0	25	50
ITV-1-60-15-50	60	1.5-15.0	8.0	25	50
ITV-1-70-20-50	70	2.0-20.0	8.0	25	50

Adjustment of external bias permits bandwidth variation. All models maintain constant gain. Supply voltages required are: +150 V; 6.3 V, filament; and 0 to 6 V, bias.

PREAMPLIFIERS —
VARIABLE
BANDWIDTH



IMV-1

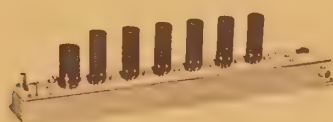
LEL main amplifiers combine the functions of a preamplifier and a postamplifier. In general, they have coaxial, low-noise inputs and provide sufficient amplification to increase a weak signal to a

level adequate for detection. All models have i-f and video outputs except the IMM-2 and ITM-1 which have video outputs only.

MAIN
AMPLIFIERS

STANDARD MODELS

Model Number	Center Frequency (MHz)	3-dB Bandwidth (MHz)	Gain (dB)	Noise Figure (dB)	Source Impedance (Ω)	Description
IF-30-30-02-50	30	2	110	2.0	50	Narrow band, general purpose
IF-30-30-02-S	30	2	110	1.5	300	Single ended mixer
IF-30-30-02-P	30	2	110	1.5	300	Balanced mixer, parallel diodes
IF-30-30-02-PP	30	2	110	1.5	300	Balanced mixer, pushpull diodes
IF-30-60-02-50	60	2	110	3.0	50	Narrow band, general purpose
IF-30-60-02-S	60	2	110	2.5	300	Single ended mixer
IF-30-60-02-P	60	2	110	2.5	300	Balanced mixer, parallel diodes
IF-30-60-02-PP	60	2	110	2.5	300	Balanced mixer, pushpull diodes
IF-30-70-02-50	70	2	110	3.5	50	Narrow band, general purpose
IF-30-70-02-S	70	2	110	3.0	300	Single ended mixer
IF-30-70-02-P	70	2	110	3.0	300	Balanced mixer, parallel diodes
IF-30-70-02-PP	70	2	110	3.0	300	Balanced mixer, pushpull diodes
IMM-2-30-10-50	30	10	90	2.0	50	Fast recovery
IMM-2-60-10-50	60	10	90	3.0	50	Fast recovery
IMM-2-70-10-50	70	10	90	3.5	50	Fast recovery
IMM-3-30-10-50	30	10	80	2.0	50	High gain stability
IMM-3-60-10-50	60	10	80	3.0	50	High gain stability
IMM-3-70-10-50	70	10	80	3.5	50	High gain stability
IF-302-60-20-50	60	20	80	3.0	50	Wide band, high gain
IF-302-70-20-50	70	20	80	3.5	50	Wide band, high gain
ITM-2-30-10-50	30	10	100	2.5	50	Solid state
ITM-2-60-10-50	60	10	100	3.0	50	Solid state
ITM-2-70-10-50	70	10	100	3.0	50	Solid state
ITM-3-30-10-50	30	10	90	25	50	Miniature solid state, mixer input available
ITM-3-60-10-50	60	10	90	25	50	Miniature solid state, mixer input available
ITM-3-70-10-50	70	10	90	25	50	Miniature solid state, mixer input available



IF-30



ITM-2

POST AMPLIFIERS

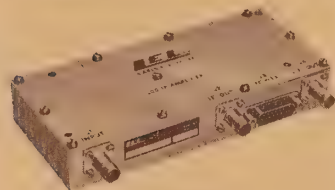
LEL post amplifiers normally operate in conjunction with preamplifiers and provide the major portion of system gain. These rugged, compact units are ideal for a wide variety of microwave system applications. All models have 50-ohm inputs.



ITA-5



ITA-7



ITA-34

STANDARD MODELS

Model Number	Center Frequency (MHz)	Output Capability (dBm)	3-dB Bandwidth (MHz)	Gain (dB)	Max. Noise Figure (dB)	Gain Control Range (dB)	Output
IMD-1-30-08-50	30	+30	8	25	—	0	IF
IMD-1-60-08-50	60	+30	8	25	—	0	IF
ITA-5-60-20-50	60	+7	20	70	7	40	IF, Video
ITA-5-160-30-50	160	+7	30	70	7	40	IF, Video
ITA-7-30-03-50	30	+7	3	75	7	50	IF, Video
ITA-7-30-10-50	30	+7	10	75	7	50	IF, Video
ITA-7-60-10-50	60	+7	10	75	7	50	IF, Video
ITA-9-30-40-50	30	+30	40	30	—	0	IF
ITA-34-21.4-03-50	21.4	+10	3	75	7	50	IF, Video
ITA-34-21.4-08-50	21.4	+10	8	75	7	50	IF, Video
ITA-34-30-03-50	30	+10	3	75	7	50	IF, Video
ITA-34-30-08-50	30	+10	8	75	7	50	IF, Video
ITA-34-60-03-50	60	+10	3	75	7	50	IF, Video
ITA-34-60-08-50	60	+10	8	75	7	50	IF, Video
ITA-35-30-03-50	30	+10	3	75	15	75	IF, Video
ITA-35-30-08-50	30	+10	8	75	15	75	IF, Video
ITA-35-60-03-50	60	+10	3	75	15	75	IF, Video
ITA-35-60-08-50	60	+10	8	75	15	75	IF, Video

POST AMPLIFIERS — PHASE AND GAIN MATCHED

LEL gain-and-phase matched postamplifiers may be used in varying combinations of 2 or 3 channel units for multichannel systems where gain-and-phase tracking are primary requirements. Characteristics of these amplifiers are matched over the temperature and gain control ranges. See also

Mixer-preamplifiers (series -10). All models have 50-ohm inputs and +10-dBm output capability. Power requirements are -20 Vdc at 80 mAdc and 0 to +10 Vdc per channel.

dual channel



ITA-8, 2

STANDARD MODELS

Model Number	Center Frequency (MHz)	3-dB Bandwidth (MHz)	Gain (dB)	Gain Control (dB)	Phase Match (deg)	Amplitude Match (dB)
ITA-8-30-03-2	30	3	65	40	2.5	1
ITA-8-30-10-2	30	10	65	40	2.5	1
ITA-8-60-03-2	60	3	65	40	2.5	1
ITA-8-60-10-2	60	10	65	40	2.5	1
ITA-8-70-03-2	70	3	65	40	2.5	1
ITA-8-70-10-2	70	10	65	40	2.5	1

triple channel

STANDARD MODELS

Model Number	Center Frequency (MHz)	3-dB Bandwidth (MHz)	Gain (dB)	Gain Control (dB)	Phase Match (deg)	Amplitude Match (dB)
ITA-8-30-03-3	30	3	65	40	3.5	1.5
ITA-8-30-10-3	30	10	65	40	3.5	1.5
ITA-8-60-03-3	60	3	65	40	3.5	1.5
ITA-8-60-10-3	60	10	65	40	3.5	1.5
ITA-8-70-03-3	70	3	65	40	3.5	1.5
ITA-8-70-10-3	70	10	65	40	3.5	1.5

LEL log amplifiers are sequential-detection logarithmic i-f amplifiers with wide dynamic range and exceptional accuracy. The ITL-2 and -4 require

—15 Vdc at 90 mAdc; models ITL-3 and ITL-5 require —20 Vdc at 70 mAdc. The ITL-6 is specially designed for pulse fidelity.

LOGARITHMIC
AMPLIFIERS —
SOLID STATE

STANDARD MODELS*							
Model Number	Center Frequency (MHz)	3-dB Bandwidth (MHz)	Input Dynamic Range (dB)	Sensitivity (mV/dB)	Input Impedance (Ω)	Log Accuracy (dB)	Output
ITL-2-30-10-50	30	10	80	20	50	± 1	Video
ITL-2-30-18-50	30	18	80	20	50	± 1	Video
ITL-2-60-10-50	60	10	80	20	50	± 1	Video
ITL-2-60-20-50	60	20	80	20	50	± 1	Video
ITL-2-70-10-50	70	10	80	20	50	± 1	Video
ITL-2-70-30-50	70	30	80	20	50	± 1	Video
ITL-2-160-10-50	160	10	80	20	50	± 2	Video
ITL-2-160-30-50	160	30	80	20	50	± 2	Video
ITL-4-30-10-50	30	10	80	20	50	± 1	Video
ITL-4-60-10-50	60	10	80	20	50	± 1	Video
ITL-4-70-10-50	70	10	80	20	50	± 1	Video
ITL-5-30-08-50	30	8	70	40	50	± 2	Video
ITL-5-60-08-50	60	8	70	40	50	± 2	Video
ITL-6-80-20-50	80	20	70	20	50	± 1	Video

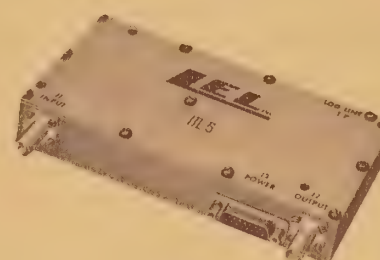
* All units are available with d-c coupled output. Linear and limited i-f output on special request.



ITL-2



ITL-4, ITL-6



ITL-5

STANDARD MODELS						
Model Number	Center Frequency (MHz)	3-dB Bandwidth (MHz)	Input Dynamic Range (dB)	Input and Output Impedance (Ω)	VSWR	IF Output (± 1 dB) (dBm)
ITLM-2-30-10-50	30	10	—70 to 0	50	2:1	0
ITLM-2-60-10-50	60	10	—70 to 0	50	2:1	0
ITLM-2-70-10-50	70	10	—70 to 0	50	2:1	0

LIMITER — IF
AMPLIFIERS —
SOLID STATE

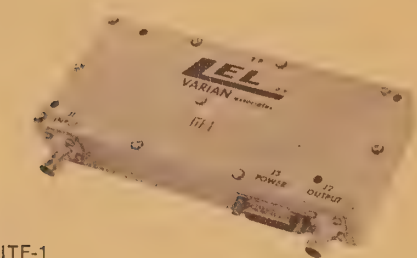


ITLM-2

IF
COMPONENTS

DISCRIMINATORS,
AFC UNITS —
SOLID STATE

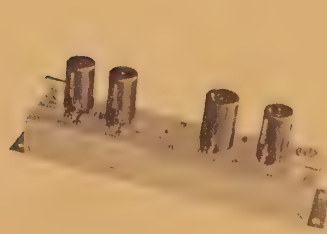
STANDARD MODELS						
Model Number	Center Frequency (MHz)	Bandwidth P-P (MHz)	Input Impedance (Ω)	Sensitivity (V/MHz)	Description	Output
ITF-1-30-10-50	30	10	50	1	Pulse discriminator with built-in limiter	Video
ITF-1-60-10-50	60	10	50	1		Video
ITF-1-60-20-50	60	20	50	1		Video
ITF-1-70-10-50	70	10	50	1		Video
ITF-1-160-10-50	160	10	50	1		Video
ITF-2-30-10-50	30	10	50	300	Search-Lock Hybrid circuit AFC unit	DC
ITF-2-60-10-50	60	10	50	300		DC
ITF-2-70-10-50	70	10	50	300		DC



ITF-1

DISCRIMINATORS,
AFC UNITS —
MINIATURE
TUBE TYPE

STANDARD MODELS						
Model Number	Center Frequency (MHz)	Bandwidth P-P (MHz)	Input Impedance (Ω)	Sensitivity (V/MHz)	Description	Output
IF-42-30-07-50	30	7	50	40	Pulse discriminator with phantastron circuit	DC
IF-42-60-07-50	60	7	50	40		
IF-32-30-08-50	30	8	50	3	FM & Pulse Discriminator	Video
IF-32-60-08-50	60	8	50	3		



IF-42

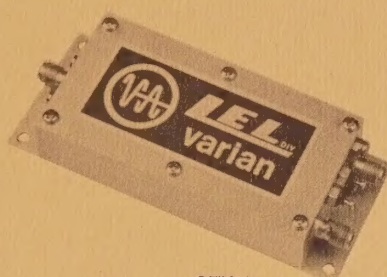


IF-32

STANDARD MODELS

Model Number	Passband (MHz)	Minimum Gain (dB)	Noise Figure Matched (dB)	Minimum Power Output† (dBm)
OTX-1-10	10-250	24	3-4	0
OTX-1-250	250-500	20	4-5	0
OTX-1-500	500-1000	20	4-5	0
OTX-1-1000	1000-2000	23	5-6	0
OTX-1-2000	2000-4000	20	9-11	0

† Higher power output models can be supplied on special request.



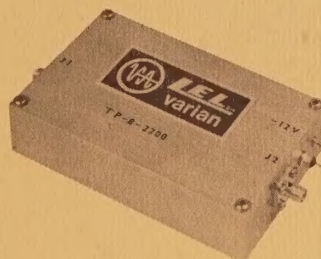
OTX-1

The OTX-1 series of low-noise, wide-band, solid-state preamplifiers are ideal for use in electronic-warfare, monopulse, and missile guidance receivers and as TWT replacements. These preamplifiers feature ultra-low noise figure, together with high input- and output-power-handling capability to minimize intermodulation and harmonic distortion. Units having lower noise figure or higher input-power versions can be furnished on special order. Modular construction and all solid-state components provide high reliability and uniformity. All units are designed to meet MIL-I-16400 and MIL-E-5400 Class II requirements.

OCTAVE AMPLIFIERS— SOLID STATE

STANDARD MODELS

Model Number	Center Frequency (MHz)	0.5-dB Bandpass (MHz)	Minimum Gain (dB)	Maximum Noise Figure (dB)	Minimum Output at 1 dB Compression (dBm)
TP-8-1435	1485	1435-1535	23	5.0	0
TP-8-2200	2250	2200-2300	23	5.5	0



TP-8

The TP-8 antenna preamplifiers provide low noise and low VSWR at a low cost. They feature wide dynamic range in a small rugged package. These solid-state preamplifiers can be phase or gain tracked and are excellent for applications in radar, electronic warfare, phased array and telemetry systems.

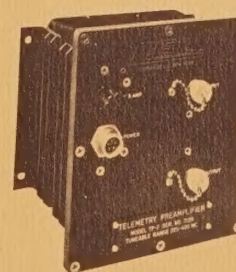
ANTENNA PREAMPLIFIERS— SOLID STATE

STANDARD MODELS

Model Number	Center Frequency (MHz)	3-dB Bandpass (MHz)	Gain (dB)	Maximum Noise Figure (dB)
TP-5-237	237	215-260	23	4.0
TP-6-136	136	131-141	23	2.5
TP-6-400	400	395-405	23	4.0
TP-7-108	108-162	3	23	2.5-3.5
TP-7-160	160-225	4	23	2.0-3.5
TP-7-225	225-400	4	20	2.5-4.5
TP-7-400	400-550	5	18	4.5-6.5

These weatherproof, pole-mounted units offer superior performance for telemetry and long range communications applications.

ANTENNA PREAMPLIFIERS— MINIATURE TUBE TYPE

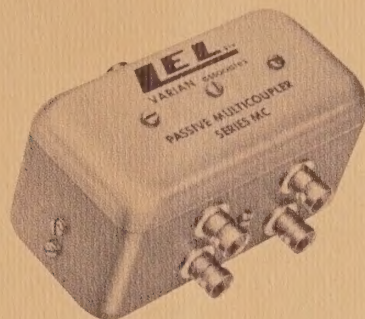


TP-7

RF COMPONENTS

LOW-LOSS PASSIVE MULTICOUPLERS

LEL MC multicouplers provide an efficient low-loss means of dividing or combining r-f power. The insertion loss as a divider is only slightly greater than that attributable to the power division, thus furnishing considerably greater efficiency than could be obtained with resistive dividers capable of the same isolation between ports. Special designs for increased isolation, number of outputs or any other octave bandwidth up to a frequency of 1 GHz are available on request.



MC-4

CHARACTERISTICS

Frequency Ranges (four models)	20 to 40 MHz 40 to 80 MHz 80 to 160 MHz 160 to 320 MHz
Number of Outputs	2, 3, 4, 6 or 8
Impedance	50 Ω
Midband VSWR	1.2:1
Input VSWR, maximum	2.0:1
Output VSWR, maximum	1.3:1
Insertion Loss, above power division	<1 dB
Midband Isolation	
Typical	30 dB
Minimum	15 dB
Connectors	Type BNC

ORDERING INFORMATION

Specify Model by Part Number

MC	-	4	-	120
Multicoupler				Center Frequency
Number of Outputs				

LOW-NOISE PREAMPLIFIERS— SOLID STATE

RTP-1 and RTP-3 preamplifiers are small, light-weight (6 oz) units having very-low power drain. All standard RTP amplifiers utilize silicon transistors for greater reliability and high-temperature operation. For lower noise figures, germanium transistor units can be provided on special order.

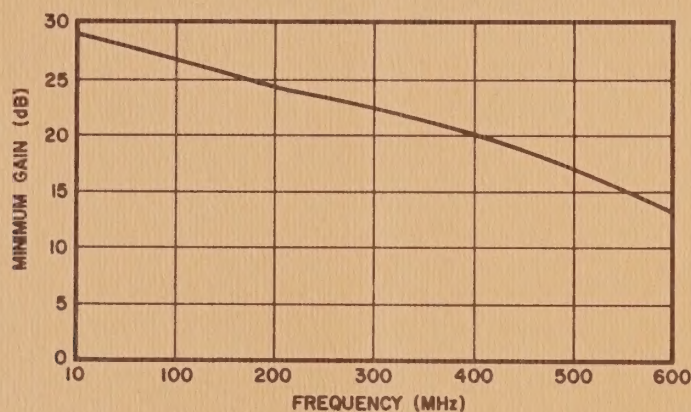


Figure 1

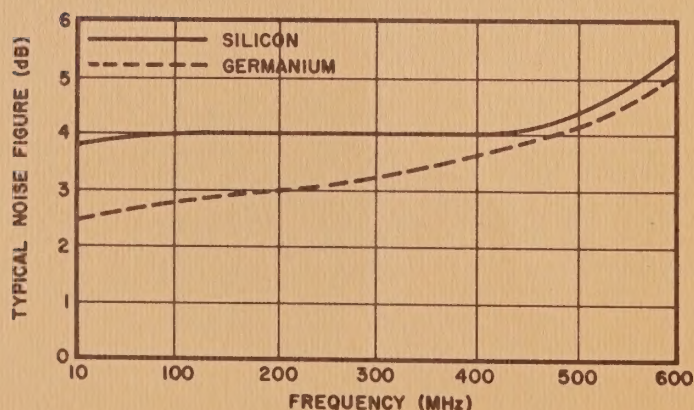
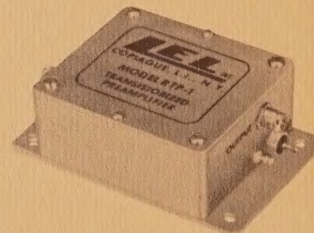


Figure 2

CHARACTERISTICS

		RTP-1	RTP-3
Center Frequency Range	(MHz)	10-400	10-400
Bandwidth, at 3 dB, minimum	(MHz)	10	10
Impedance			
Source	(Ω)	50	50
Load	(Ω)	50	50
Gain		see Figure 1	
Noise Figure		see Figure 2	
Supply Voltage			
Silicon	(Vdc)	-20	-20
Germanium	(Vdc)	+20	+20
Supply Current			
Silicon	(mAdc)	10	10
Germanium	(mAdc)	10	10



RTP-1



RTP-3

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CMC	8	KAB	6	SDC	4
CSI	9	KAH	6	SFC	5
DSB	9	KBH	6	SFCM	2
IF30	11	KCH	6	SMC	8
IF31	10	KDH	6	TP	15
IF32	14	KFT	6	UFG	6
IF42	14	KGT	6	XAH	6
IF302	11	LAC	6	XBH	6
IHP	2	LAK	6	XCH	6
IMD	12	LFC	5	XDB	6
IMM	11	LMC	8	XDH	6
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